CA-IR-11

Ref: T-4, Page 4 and 16.

Please provide copies of the load flow studies prepared by HECO for the EOTP including the East Oahu 138 kV Requirements Study (July 1991 and August 1992), the East Oahu Transmission Requirements Update Study (March 1998), the 1994 Kamoku Pukele 46 kV Alternatives Study (and any updates to this study), the 2003 East Oahu Alternatives Study Update (December 2003), the East Oahu Transmission Project: Options to the Koolau/Pukele Transmission Line Overload Problem (December 2003) and any other internal load flow studies which are pertinent for the instant docket. Load flows should be provided electronically in PTI RAW format (latest version that is licensed to HECO). In addition, hard copies of load flow one line diagrams should be provided for each case (or group of cases to which the one line diagram is applicable). If internal cases exist that include the 46 kV system as well as the 138 kV system, please provide such cases as well.

HECO Response:

HECO objects to providing load flows for the July 1991, August 1992 and 1994 Kamoku Pukele 46kV Alternatives Study as they are studies which are more than 10 years old and these studies have been updated in the 1998 and 2003 studies. In addition, these files will be unduly burdensome to identify in the computer archives and most of the engineers that conducted the load flows have either retired, moved to a different part of the company or are no longer employed by HECO. Not withstanding this objection, a copy of the load flows for the March 1998 and two of the December 2003 East Oahu studies have been provided in PTI RAW format. HECO objects to providing hard copies of load flow one line diagrams for each case because it would be unduly burdensome to create a one line diagram (or a group of diagrams for several cases). Not withstanding this objection, one line diagrams have been provided for the cases in which one line diagrams have been created for the March 1998 and two December 2003 reports.

HECO ST-4, pages 6-8, indicated that Phase 1 and Phase 2 of the Kamoku 46kV Underground Alternative – Expanded would allow 90 MW of existing load to be shifted from the Pukele Substation to Archer and Kamoku Substations (which would resolve the Koolau/Pukele

Line Overload Situation). This was based on loads at the various HECO substations at the time of the 2002 Day Peak and incorporated proposed changes to Phase 1 of the Kamoku 46kV Underground Alternative – Expanded as described in HECO ST-2.

As is indicated in the draft Environmental Assessment, HECO's 2002 Day Peak occurred on July 30, 2002 and the 2003 Day Peak occurred on July 27, 2003. Changes have occurred in between the time of the 2002 Day Peak and 2003 Day Peak that had an effect on the loads at Pukele Substation and Archer Substation. At the time of the 2002 Day Peak, Pukele Substation served 192 MW, and Archer Substation served 90 MW. Through normal distribution planning activities, several changes have and will occur to the 46kV sub-transmission system, which will change how the Pukele Substation and Archer Substation are loaded. Some of the changes described below were completed prior to the 2003 Day Peak and the future change, which is expected to be implemented in 2004 will be implemented prior to Phase 1 of the EOTP Project.

(1) McCully Transformer #1 (McCully 1) was removed from McCully Substation and installed at Waialua Substation to meet the growing load demand in this area. The load that McCully 1 served was redistributed onto two other McCully transformers. (This could be done because some of the transformers at McCully Substation are lightly loaded, as loads previously served from the 46kV system at the McCully Substation were transferred to the 25kV distribution system, which is served from the Kewalo and Kamoku Substations. Load demand in the western portion of Oahu required additional transformation capability to convert power from a voltage level of 46kV to 12kV.) At the time of the 2002 Day Peak, McCully 1 served 4.3 MW. Approximately one-half of this load was moved from McCully 1 to McCully Transformer #5 (McCully 5) and the other one-half of the load was moved from McCully Transformer #6 (McCully 6). McCully 5

and McCully 6 are served from the Pukele Substation using the Pukele 4 and Pukele 2 46kV circuits, respectively. McCully 1 was served from the Archer Substation using the Archer 41 circuit, and the removal of McCully 1 shifted 4.3 MW of load from Archer Substation to the Pukele Substation.

(2) In order to minimize the impact of shifting McCully 1 load to other McCully transformers served from the Pukele Substation, switching can be done at McCully Substation that will transfer the load from McCully 6, which is served by the Pukele 2 46kV circuit, to the Archer 43 46kV circuit. The switching is expected to occur in 2004 and will shift 6.24 MW of load from Pukele Substation to Archer Substation.

(3) For the same reasons as described for McCully 1, McCully Transformer #3 (McCully 3) was removed from McCully Substation and relocated to Makakilo Substation to meet the growing load demand in the Makakilo area. At the time of the 2002 Day Peak, McCully 3 served 2.1 MW of load, and 1.7 MW of this load was redistributed to McCully Transformer #2 (McCully 2) and 0.3 MW of the load, which served the Convention Center, was moved to the 25kV distribution system (which is served from Kewalo or Kamoku Substation). McCully 3 was served from the Pukele Substation using the Pukele 5 46kV circuit. McCully 2 is served from the Archer Substation using the Archer 43 46kV circuit, and the removal of McCully 3 shifted 1.7 MW of load from Pukele Substation to Archer Substation.

(4) At the time of the 2002 Day Peak, Aina Koa Substation was served by two 46kV circuits from the Koolau Substation. If one of the 46kV circuits is unavailable, the second 46kV circuit would serve the load demand of the entire Aina Koa Substation. Having 46kV circuits from two transmission substations feed a distribution substation is a

preferred way of operating the 46kV system, and existing switches on the 46kV system made it relatively easy and low cost to serve one of the two transformers at Aina Koa Substation from the Pukele Substation and the 2nd Aina Koa transformer from Koolau Substation. This shifted 8 MW of load from Koolau Substation to Pukele Substation. This shift had no impact on the combined Koolau/Pukele Area load, but altered the allocation of the load between the two substations.

(5) A portion of the Hawaii Convention Center load was served from McCully 5, McCully 6 and McCully 3. Approximately 0.5 MW from each of McCully 5 and McCully 6 was transferred to the 25kV system (which is served from Kewalo or Kamoku Substation). This decreased the load on McCully 5 (which is served from Pukele Substation) and McCully 6 (which is currently served from Pukele Substation, but will be served from Archer Substation after the McCully 6 switch referred to above) by about 0.5 MW for each transformer. The Downtown Substation load served by Kewalo and Kamoku Substations will be increased by 0.5 MW because this load was shifted from McCully 5 to the 25 kV system. The 0.5 MW of load shifted from McCully 6 to the 25kV system is part of the 6.24 MW of load that is being shifted when the McCully 6 transformer is transferred to the Archer Substation. (5.75 MW will be shifted to Archer Substation and 0.5 MW was shifted to the 25kV system served by Kewalo and Kamoku Substations).

These are normal changes in the sub-transmission (46kV) and distribution (12kV and below) system configurations that are made from time-to-time as a result of distribution planning to better balance circuit and transformer loads, address circuit reliability issues, and optimize use

of the utility grid. In many instances, the changes are made by manually opening or closing existing circuit switches.

HECO Load Forecast

At the time of the 2002 Day Peak (which occurred on July 30, 2002), the load for the Koolau/Pukele area was 346 MW, or 30% of the load served by HECO, and the load for the Downtown area was 304 MW, or 26% of the HECO service load. The Koolau/Pukele area load of 346 MW included 192 MW (or 16.4% of the HECO service load) served by Pukele Substation, and 154 MW (or 13.2% of the HECO service load) served by Koolau Substation. The load flows for the December 2003 reports provided in response to this IR (Exhibit 5 and Exhibit 6 of the Application) reflect load data at the time of the 2002 Day Peak prior to changes on the distribution system.

At the time of the 2002 Day Peak (as adjusted for the distribution system changes), the load for the Koolau/Pukele area was 342 MW, or 29% of the load served by HECO, and the load for the Downtown area was 309 MW, or 26.5% of the HECO service load. The Koolau/Pukele area load of 342 MW included 196 MW (or 17% of the HECO service load) served by Pukele Substation, and 146 MW (or 12.5% of the HECO service load) served by Koolau Substation. HECO did not rerun the load flow analysis to reflect the 2002 Day Peak information and therefore will not be providing these cases in PTI RAW format.

At the time of the 2003 Day Peak (as adjusted for the changes), the load for the Koolau/Pukele area was 352 MW, or 30% of the load served by HECO, and the load for the Downtown area was 297 MW, or 25% of the HECO service load. The Koolau/Pukele area load of 352 MW included 209 MW (or 18% of the HECO service load) served by Pukele Substation, and 143 MW (or 12% of the HECO service load) served by Koolau Substation. HECO

performed internal load flows on portions of the Archer Substation and Pukele Substation in support of Enertech's Magnetic Field Evaluation described in HECO ST-10. The 46kV system load flows reflect loads for the Archer Substation and Pukele Substation at the time of the 2003 Day Peak and are attached to this IR response.

To project the service area day peak loads for the December 2003 transmission planning studies supporting the need for the 46kV Phased Project, the service area loads at the time of (i.e., coincident with) the system Day Peak for 2002 (which occurred on July 30, 2002) were projected to grow at the forecast growth rates for the system Day Peak in HECO's latest long-term forecast at the time (the August 2002 Long-Term Sales and Peak Forecast).

Actual load growth rates may differ from those forecast for a number of reasons, such as changes in the population growth, economic growth and customer electricity consumption factors that drive electricity load growth. Changes in load growth rates from those forecast may impact the timing of the Downtown Overload Situation, but will not impact the Pukele and Downtown Substation Reliability Concerns (which result from the number of lines serving the substations, rather than the growing loads on the lines), and are unlikely to defer the Koolau/Pukele Overload Situation (due to the loads already experienced on the lines serving the area).

The adjusted loads for the Koolau/Pukele service area were 342 MW in 2002 and 352 MW in 2003. (The unadjusted loads were higher.) The overload level is 362 MW. Also, HECO's latest Long-Term Sales and Peak Load Forecast, completed in February 2004 as part of its integrated resource planning process, forecasts higher, not lower, growth rates. While it may be possible to slow the rate of load growth in the area through the use of energy conservation

measures and distributed generation (which are reflected to varying degrees in the load forecasts), it is not expected that these measures will eliminate load growth.

Based on the 2002 Day Peak loads and the August 2002 projected load growth rates for the Day Peak, the Downtown Overload Situation was forecast to occur in 2023 with HPP operating, and 2006 without HPP. The 2002 load for the Downtown area, if subsequent 46kV configuration changes and 25kV distribution circuit additions had already been implemented, would have been higher by 5 MW. If the forecast loads for the Downtown area were based on the adjusted 2002 load (which was 5 MW higher) and the same projected load growth rates, then the forecast overload years for the Downtown Overload Situation would move up to 2021 with the HPP operating and 2005 without HPP.

Distribution Planning Considerations

For distribution planning purposes, a substation with four 80 MVA transformers, which is how the Pukele Substation is configured, is capped at 240 MVA. This is to account for an N-1 contingency on the distribution system. If the load is capped at 240 MVA, the entire 240 MVA of load can still be served because if one transformer at the Pukele Substation is lost, the other three remaining transformers will be able to serve the load for that substation.

The Pukele Substation load at the time of the 2002 Day Peak (without any adjustmenst for the distribution system changes) was 192 MW. This load was escalated based on the forecasted Evening Peak growth rates because the load at the Pukele Substation is higher during the Evening Peak hours compared to the Day Peak hours. The escalated load at the Pukele Substation will reach the 240 MVA limit in the year 2015. Beginning in the year 2016 it was assumed that future load growth in the Pukele service area will be served by the Downtown Area Substations of Archer, Kewalo and Kamoku Substations. The load growth of the Downtown

Area Substations and the added load from the Pukele Substation (because the Pukele Substation was capped at 240 MVA) forecasted that the Dowtnown Line Overload would occur in 2023.

The 2002 Day Peak load (as adjusted for distribution system changes) would increase the Pukele Substation load by 5 MW to 196 MW as explained earlier. If the Pukele Substation load is escalated using forecasted Evening Peak escalation rates, the Pukele Substation load will reach the 240 MVA limit in the year 2014. Therefore with the increased load of 5 MW (because of the various distribution system changes), the forecasted load growth of the Downtown Area Substations, and the added load from the Pukele Substation, which was accelerated by one year because of the various distribution changes, the Downtown Line Overload Situation is forecasted to occur in 2021

Operational Effectiveness

The implementation of the EOTP would allow electrical loads currently being served exclusively from Pukele Substation, located at the end of the Northern 138kV transmission corridor, to also be served from Kamoku Substation and Archer Substation, located in the Southern 138kV transmission corridor. Essentially, this project allows load to be shifted among the three substations using 46kV lines, and also allows the substations to back up each other. These operating features will address the four transmission problems in varying degrees.

First, some of Pukele Substation's existing electrical load would be shifted to Archer Substation and Kamoku Substation with the implementation of the project. This will reduce the overall Koolau/Pukele Service Area load, which will relieve the potential overload situation of the 138kV transmission lines transporting power to the area.

Second, most of the loads transferred from Pukele Substation to Archer Substation and Kamoku Substation as a result of the implementation of this alternative, plus some existing load

currently served by Archer Substation, could temporarily be shifted back to Pukele Substation when a transmission line providing power to the Downtown Area is taken out of service for maintenance. This would reduce the load in the Downtown Area while the line is out of service, and defer the potential overload situation of the 138kV transmission lines transporting power to the area (or avoid accelerating the overload situation, depending on the amount of load that could be temporarily shifted). This load shift would only be done when there is a possibility that the overload situation would occur. After the line taken out for maintenance has been restored to service, load would be shifted back from Pukele Substation to the Downtown Area.

Third, some of Pukele Substation's existing electrical load would be shifted to Archer Substation and Kamoku Substation with the implementation of this alternative. Therefore, if the two 138kV transmission lines serving Pukele Substation were to be lost, the loads that were transferred to Archer Substation and Kamoku Substation because of this alternative would not experience an outage. The loads that continue to be served by Pukele Substation even after the implementation of this alternative would experience a momentary outage (approximately six seconds) as these loads are automatically transferred to Archer Substation and Kamoku Substation (as well as to Koolau Substation).

Fourth, if the two 138kV transmission lines that serve Archer Substation are lost, some of the loads served by Archer Substation, Kewalo Substation, and Kamoku Substation would experience an outage, but other Archer Substation loads would experience a momentary outage (approximately six seconds) as these loads are automatically transferred to Pukele Substation.

Koolau/Pukele Overload Situation

With the installation of Phase 1, approximately 80 MW of existing load (based on 2002 Day Peak loads, as adjusted to account for the distribution circuit re-configuration activities from

2002-2004 discussed above), which is or will be served from the Pukele Substation prior to Phase 1, will be transferred from the Northern Corridor to the Southern Corridor and will be served by the Archer and Kamoku Substations. The load shift is expected to remain in this configuration under normal operating conditions and will reduce the combined MW load demand from the Koolau and Pukele Substations to a level below 362 MW, which is the amount of combined load at Koolau and Pukele Substations that triggers an overload condition on the remaining line to Koolau Substation. The reduction in combined load with the implementation of Phase 1 will eliminate the Koolau/Pukele Overload Situation for the 20-year period studied.

Pukele Substation Reliability Concern

Under the existing configuration, loss of the two Koolau-Pukele 138kV transmission lines serving the Pukele Substation will cause an interruption of electricity service to customers. Most of HECO's customers in the area serviced by the substation, which extends from Makiki to Waikiki, and from Koolau to Kaimuki, would be out of power until one of the two 138kV transmission lines could be restored to service. (The remaining customers would experience a service interruption of up to six seconds as their service is automatically transferred to Archer Substation.)

If Phase 1 is installed, the customers transferred to circuits served by the Kamoku Substation and Archer Substation (representing 80 MW, based on 2002 Day Peaks, as adjusted) would not experience a loss of electricity service if both the Koolau-Pukele 138kV transmission lines are unavailable (causing an outage of the Pukele Substation), therefore substantially increasing the reliability to the customers served by these circuits. In addition, if an outage of the Pukele Substation occurs, approximately 63 MW (based on 2002 Day Peak loads, as adjusted, and not including the 80 MW of load that will be permanently shifted from Pukele

Substation to Archer and Kamoku Substations) of the existing Pukele Substation will automatically be transferred to the Archer, Kamoku and Koolau Substations. Customers on the Pukele 3 and some customers on the Pukele 6 and Pukele 8 46kV circuits will automatically be transferred to the new Kamoku and Archer circuits at the different distribution substations served by the Pukele circuits. (For instance, if the Pukele 3 46kV circuit suddenly loses its feed from the Pukele Substation, automatic switching will occur at Kapahulu and Kaimuki Substations to transfer the load from the Pukele 3 46kV circuit onto the new Kamoku circuit.) Customers served by the Aina Koa Substation fed from the Pukele 1 46kV circuit will be transferred to circuits served by the Koolau Substation. The automatic transfer scheme requires up to 6 seconds for mechanical switches to open and close transferring the load from the primary circuits served from the Pukele Substation in the Northern Corridor to the back-up circuits served from the Kamoku and Archer Substations in the Southern Corridor. Therefore, customers included in the 63 MW block will experience up to a 6-second outage.

With respect to the remaining customers served from the Pukele Substation after Phase 1 is installed (representing 27 MW based on 2002 Day Peaks, as adjusted), during a prolonged outage of the Pukele Substation, HECO Troublemen will be sent out to perform manual switching in the field. The switching will transfer the remaining Pukele load to 46kV feeders at a different part of the Northern Corridor served by the Koolau Substation. The Manual switching is expected to require approximately 2 to 4 hours to complete before service is restored to the remaining customers. Table 1 describes the effectiveness of Phase 1 in addressing the Pukele Substation Reliability Concern.

Table 1.

Kamoku 46 kV Underground Alternative
Pukele Reliability Concern
Substation Impact Comparison

No Interruption	6-sec. Interruption	2 to 4 hour Outage
McCully	Aina Koa (portion)	Kahala
Ena (portion)	Ena (portion)	Waialae
Waikiki (portion)	Waikiki (portion)	Pukele
Kapahulu (portion)	Kapahulu (portion)	Manoa
Kapiolani (portion)	Kapiolani (portion)	Woodlawn
Kaimuki (portion)	Kaimuki (portion)	UH-Quarry
Kuhio	Moiliili	East-West Center

Downtown Line Overload Situation

If the 80 MW transferred to Archer and Kamoku Substations continues to be served by these substations in situations in which two out of the three Downtown 138kV transmission lines could be out of service, the Downtown overload situation will be accelerated. However, with the installation of the EOTP, it is HECO's plan to shift approximately 71 MW back to the Pukele Substation if one of the Downtown 138kV lines is taken out of service for maintenance, or experiences a prolonged forced outage.

The sub-transmission system utilizes overhead and underground sub-transmission lines to serve distribution transformers, which transform the power from a voltage of 46 kV to a 12 kV distribution voltage. Each 46 kV circuit can serve a limited number of 46-12kV transformers, because the 46 kV circuit is limited by its current carrying capacity. As a general rule of thumb, a 46 kV circuit utilizing a 556.6 MCM aluminum conductor can serve approximately 8 transformers carrying approximately 8 MVA of load for a total of 64 MVA per 46 kV circuit. If,

for example, each transformer only carried 4 MVA of load, then the 46 kV circuit could possibly serve additional transformers. In planning for the distribution system, automatic transfers also must be considered. To allow for automatic transfers in the event of a line outage, switches are installed that would automatically initiate a transfer of electrical load from one feeder to the other feeder if a feeder was lost. For instance, Waikiki Transformer #2 (Waikiki 2) will be served from the Pukele Substation with the installation of Phase 1. If a loss of service should occur at the Pukele Substation or the Pukele 5 46kV circuit, the Waikiki 2 load at Waikiki Substation being served by Pukele Substation would automatically be transferred onto the Archer 41 46kV circuit. Therefore, when designing how many 46-12 kV transformers Archer 41 will serve, both the normal transformer loads (transformers that will normally be served by Archer 41), and the load which will be automatically transferred from another circuit to Archer 41, must be considered.

With the installation of Phase 1, the Pukele circuits will be reconfigured so that only a portion of the load transferred to Archer and Kamoku Substations can be transferred back to Pukele Substation from Archer and Kamoku Substations, because of the limitations on the 46 kV circuits and the automatic transfers that need to be considered. As a result, not all of the 80 MW of load shifted from Pukele Substation to the Downtown Substations can be transferred back to Pukele Substation when maintenance is being performed on one of the downtown transmission lines. Based on the planned circuit configuration, approximately 9 MW originally served by the Pukele Substation will not be transferred back from the Archer Substation.

The remaining 9 MW of load, which cannot be shifted, can be replaced by temporarily shifting additional load from the Piikoi Substation (located between the Archer and Pukele Substations) to the Pukele Substation. Based on 2002 Day Peak loads, Piikoi Transformer #2

(Piikoi 2) and Piikoi Transformer #3 (Piikoi 3) served 14 MW of load demand. Piikoi Substation is served by the Archer Substation prior to and after Phase 1 using the Archer 43 and Archer 42 46kV circuits. Using the existing 46kV system, manual switching can be performed at Piikoi Substation to serve Piikoi 1 and Piikoi 2 from Pukele Substation using the Pukele 5 circuit. When the switching is performed, 14 MW, which was not originally served by Pukele Substation, will be shifted from Archer to Pukele Substation. This action will shift the remaining 9 MW of load from the Downtown Area Substations to the Pukele Substation and also shift an additional 5 MW of load (which is now on the Downtown Area Substations because of the various 46kV and 25kV distribution changes) from the Downtown Area Substations to the Pukele Substation. This will return the HECO 46 kV system to its 2002 Day Peak load condition where the Downtown Line Overload Situation is projected to occur in the year 2006 using the August 2002 HECO Base Forecast and assuming HPP is retired.

If the HPP is not retired, the forecasted Downtown Line Overload Situation is forecasted for 2021. With the installation Phase 1 of the Kamoku 46kV Underground Alternative - Expanded, the normal state would be to shift approximately 80 MW of load from Pukele Substation to Archer and Kamoku Substations. Therefore, the Pukele Substation load will decrease to 116 MW. If the 116 MW is escalated using the forecasted Evening Peak growth rates, the Pukele Substation will not reach the 240 MVA limit in the 20-year planning period studied and load from the Pukele Substation will not be shifted to the Downtown Area Substations. HECO T-4 explained that the installation of the Kamoku 46kV Underground Alternative – Expanded and shifting a portion of the existing load from the Piikoi Substation to the Pukele Substation would defer the Downtown Line Overload by approximately 3 years from 2023 to 2026. In determining the deferral, HECO T-4 continued to cap the Pukele Substation at

240 MVA even with the installation of the Kamoku 46kV Underground Alternative - Expanded, which was in error.

If maintenance is required on the 138kV transmission lines feeding the Downtown Substations and the Kamoku 46kV Underground Alternative – Expanded project is installed, 71 MW of load (which was originally served by the Pukele Substation) plus a portion of the Piikoi load would be shifted to the Pukele Substations. This would then cause the load at the Pukele Substation to exceed the 240 MVA limit beginning in 2014, which would be acceptable if all four 80 MVA transformers were in service. If a contingency then occurred on the distribution system where one of the transformers at the Pukele Substation were out of service, HECO could either reschedule the maintenance on the Downtown 138kV transmission line (which would not require HECO to shift the 71 MW of load plus the Piikoi load to be shifted to the Pukele Substation) until the transformer at the Pukele Substation is placed back in service, or HECO could look into shifting only a portion of the Downtown load (through the use of manual switching on the 46kV system) to the Pukele Substation so the three remaining transformers at the Pukele Substation would not be overloaded and HECO could control the Downtown Line Overload Situation.

If the 240 MVA cap at the Pukele Substation is not considered and a portion of the Piikoi load is transferred from the Downtown Area Substations to the Pukele Substations when maintenance is being performed on the 138kV transmission lines feeding the Downtown Area Substations, the Downtown Line Overload Situation is forecasted to occur in 2028. In addition, if the Downtown Overload Situation continues to develop as projected in the 2023 time frame, HECO could create the flexibility (with minor circuit modifications that are not currently planned) to shift additional load to Pukele Substation when a Downtown Area transmission line

is taken out of service for maintenance, which could defer the overload situation for up to a few years.

Downtown Substation Reliability

Phase 1 of the EOTP will improve service reliability to a portion of the Downtown Substation loads by providing a back-up source of power to 47% of the load served by the Archer, Kewalo and Kamoku Substations if Archer should lose its two 138kV transmission feeds.

Phase 2 of the Kamoku 46kV Underground Alternative - Expanded

Phase 2 involves the installation of an 80 MVA 138kV-46kV transformer at Archer Substation and three new underground 46kV circuits (Archer 45, Archer 47 and Archer 48) to connect the new circuits from the 80 MVA transformer at Archer Substation to the three existing 46kV circuits (Pukele 7, Pukele 6 and Pukele 5) terminating at the Pukele Substation.

The three new Archer circuits are essentially an extension of the three Pukele circuits to Archer Substation. The new transformer at Archer Substation and the three new circuits will allow the remaining Pukele Substation loads (which would require up to 2 to 4 hours to restore during a prolonged Pukele Substation outage even after the installation of Phase 1) to be automatically transferred from the Pukele Substation to Archer Substation within 6 seconds. The transfers will occur by activation of automatic transfer switches if the Pukele Substation should lose both Koolau-Pukele 138kV transmission lines. Transfers will take place through the EMS if various Pukele 46kV circuits require an outage. The Pukele 5, 6 and 7 46kV circuits will continue to be served by the Pukele Substation during normal operation after Phase 2 is installed.

The effectiveness of the EOTP Project after the implementation of Phase 2 in addressing the Koolau/Pukele Overload Situation, the Downtown Line Overload Situation and the

Downtown Substation Reliability Concern remains the same as described with the implementation of Phase 1. Phase 2 improves on the effectiveness of the project in addressing the Pukele Substation Reliability Concern, because the remaining customers served by the Pukele Substation that would have experienced an outage lasting up to 2 to 4 hours will be interrupted for only 6 seconds or less (significantly less than 2 to 4 hours), which is the time required for the automatic transfer equipment to complete the switching. See Table 2 for a summary of the effectiveness of Phase 2 to address the Pukele Substation Reliability Concern.

Table 2.

Kamoku 46 kV Underground - Expanded Alternative
Pukele Reliability Concern
Substation Impact Comparison

No Interruption	6-sec. Interruption		2 to 4 hour Outage
McCully	Aina Koa (portion)	Kahala	None
Ena (portion)	Ena (portion)	Waialae	
Waikiki (portion)	Waikiki (portion)	Pukele	
Kapahulu (portion)	Kapahulu (portion)	Manoa	
Kapiolani (portion)	Kapiolani (portion)	Woodlawn	
Kaimuki (portion)	Kaimuki (portion)	UH-Quarry	
Kuhio	Moiliili	East-West Center	

Summary

PTI RAW data files are provided in this IR response for the March 1998 East Oahu Transmission Requirements Update Study. Draw files representing single line diagrams for the existing system and the five options studied are provided in response to this IR.

PTI RAW data files are provided in this IR response representing the 2002 Day Peak data (not adjusted for the distribution changes) for the 2003 East Oahu Alternatives Study Update

(December 2003) and the East Oahu Transmission Project: Options to the Koolau/Pukele Transmission Line Overload Problem (December 2003) studies. A number of draw files representing single line diagrams for the analysis are provided. Refer to the electronic spreadsheet which provides an index for the RAW data files and the draw files.

PTI RAW data files for portions of the Archer and Pukele Substations are provided in this IR response with their corresponding draw files. PTI RAW data files for the existing system, Phase 1 and Phase 2 of the Kamoku 46kV Underground Alterative- Expanded with 2003 Day Peak load data are provided in this IR response. The 2003 Day Peak load data includes all distribution changes which have occurred between the 2002 and 2003 Day Peak as described earlier. The cases represented as "arch46ph2e" and "puk46ph2e" represent the Archer Substation and Pukele Substation, respectively during the loss of two 138kV feeds to the Pukele Substation.